The "Seasonal Bog" Garden
An Alternative Method of *Sarracenia* Cultivation for the Northern* Grower

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When I stepped into my house just back from the garden center, with a smile on my face from ear to ear, holding out in front of me for my wife to see, a $5.29 pot of *S. purpurea*, I never imagined that my lifestyle would become intoxicated by the secretion of nectar.

I was always curious about nature. As a child, the excitement I had running up to my grandma's large concrete lily pond hoping to see strange creatures and later as a teenager, exploring the local fresh water marshes every Sunday while the family got together for dinner. I was always bringing some form of plant or animal life home to study or donate to my high school science classes. Wetland ecology and the natural world in general established a place in my heart during those formative years.

*The author lives just inside zone 6, with an average min. temp. of -10 - O° F. and classifies all N.A. CP growers living in zones 7 - 2 (regardless of latitude), as outlined on a **U.S.D.A. Hardiness Zone Map** as "northern".

After four years in the military during the Vietnam Conflict, I made it a point to give my family the opportunities to experience the wonders of pond life as I had years before.

But, I never had the chance to become acquainted with bogs; and the day my wife came home from the store with a jewellike sundew, I was instantly enchanted. The plant lived for my wife about two months. It was during this time that I told her that I decided to grow CP.

My first year was very challenging and rewarding. In addition to taking notes on all manifestations of my pot of *S. purpurea ssp.*_ due to cultivation, buying three *Dionaea* plants and the joy of locating my first colony of *D. rotundifolia* while doing survey work (Stahle 1985:52). I was trying to obtain books on CP wherever possible, but it was also a very disturbing and frustrating time. Feeling responsibility to my plants, I was afraid to turn my back on them for more than a day or two, which warned me of the pitfalls of overextending oneself beyond one's time and facilities. As a result, I sat down and made a critical evaluation of my long term interests, incorporating Koopowitz's school of thought (Koopowitz & Kaye, 1983). I must admit that I bit my lip hard a few times; but I decided to limit myself to N.A. CP.

I agree with the philosophy that CP are not house plants (Bell 1976:vi), and should be grown outdoors to achieve maximum growth potentials (Hummer 1979:78, Schnell 1976:96) as well as affording them the natural setting that their beauty deserves. But,in the back of my mind, I was constantly haunted by the fact that I lived in a northern environment. I had to establish a method of cultivation to accommodate southern *Sarracenia* or be content with growing a few selected plants (Hummer 1979:78, Schnell 1976:100,109, Slack 1980:192), which I wasn't.

Another thing that bothered me was the sparsity of people growing CP which I felt was due, in part, to lack of an easy, standardized method of cultivation and a more affordable set-up. Once I started appraising greenhouses and calculating costs and overhead, I was convinced that this system's costs prevented the northern market for CP from expanding, at least comparable to the water lily garden trade.

With these thoughts in mind, it became obvious that a standardized system of outdoor cultivation for a wider spectrum of growers was needed. Good cultivation, affordable set-up, plus minimum operating costs and maintenance became primary objectives.

A review of literature on outside cultivation of CP was made in order to learn about technologies in use, while culling those technologies that I felt could be incorporated into the projected system.

The following information is the result of the author's attempt to achieve the above goals, plus notes since 1986.

If one finds it heartbreaking or unacceptable to have heavy rain, hail, nibbling insects or animals take their toll of foliage (Hummer 1979:95, Schnell 1976:109, Slack 1980:193), then bog gardening may not be for you. I shook many a fist at robins which are my biggest aggravation. All things aside though, the rewards and gratification of outdoor cultivation to me outweigh any bird or starving insect.

The primary tools needed are: BASKETS. Swenson briefly mentioned: "We have found that plants placed pot and all into the soil in a bog or moist woodland location will thrive all summer". (Swenson 1977:10).

Realizing the significance of such flexibility, I crossed over to the water lily trade and adopted their planting baskets (Figure 1). Made of a top quality composition to withstand water and handling, these baskets allow water to pass through the compost in a more natural way. They also provide good aeration of compost, prevents salts from accumulating and buffers the pH of your potting compost through the natural process of seepage. Root systems are also free to expand at will, reducing rootbinding. With these factors recognized, repotting is less frequent, reducing root disturbance which *Sarracenia dis*like with a passion (Schnell 1977:162, 1978:10, 1980:111), at the same time making it possible to rearrange your bog to obtain different effects. At the onset of freezing weather, plants can then be "lifted" for storage.

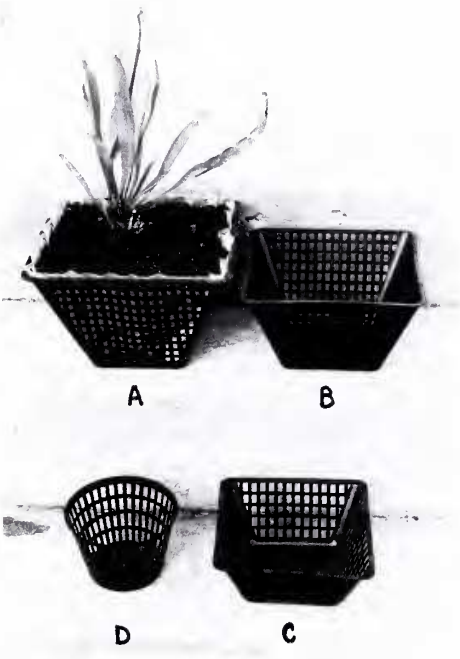

Figure 1. Planting Baskets

Sold in association with these planting baskets are burlap liners called Hessian Squares. These are used to prevent loss of soil. Feeling that the decomposition of such liners would add unknown trace elements to my *Sarracenia* compost and/or alter the pH, I substituted the burlap with the purchase of what is commonly called "bridal veil". This item is less bulky and very open in structure.

The baskets should also be modified to give better drainage for bog use by drilling nine 1/2 inch size holes through the bottom section in all square baskets regardless of size (not shown).

Figure 1 shows sizes available: A - Large square 10 inches by 7 inches deep; B - Medium square 9 inches by 5 1/2 inches deep; C - Small square 7 1/2 inches by 3 1/2 inches deep; D - Round 5 3/4 inches by 4 inches deep. All measurements are inside. I strongly suggest the use of baskets that are not less than 5 inches deep.

These baskets are a product of England. The number of water lily dealers in the USA that handle this product is unknown to me. In 1985, I made one long-range projected purchase of these baskets from Lilypons Water Gardens. Since that purchase, Lilypons decided not to carry this item. Baskets are currently being offered by: William Tricker, Inc. (P.O. Box 31267; 7125 Tanglewood Drive; Independence, Ohio 44131; Ph. (216) 524-3491 or 3492)

Besides the sizes mentioned earlier, a large round basket, 9 inches by 5 inches deep is also available. The Tricker organization is very excited about adding baskets to their product line and is looking forward to helping ICPS members with their needs (Burk 1989). For overseas members, write to: Blagdon Water Garden Center Ltd., Church Street, Blagdon, Bristol B518-6RZ U.K.

Now one can purchase plastic baskets from department stores at a lower cost, but durability due to composition (less rubber) might be questionable, resulting in more expense in the long run. Another CP grower is currently experimenting with another type basket in a modified system. In perspective, this tool is available in one way or another.

Cold Storage

Pantries and basements are poor areas to keep your plants during dormancy due to the uncontrollable fluctuation of temperatures. This factor will cause disturbed and inadequate rest as well as premature growth starts which the northern grower must avoid at all costs until the right moment to safely move outside.

I take my baskets of plants to a local business that provides ice and cold storage for the community which is agricultural-industrial. You rent space as needed, floor or rack. Once inside, you can see anything from crates of apples or string beans to kegs of beer. I also spotted pots of small shrubs on racks one year. The storage building is fairly large and separate from the ice house and is kept cold at a constant 33°F. all year. This building is lit all day, but to a degree that plants do not benefit. An excellent air circulation system is in constant use. With back-up equipment in case of breakdown, I can sleep well at night.

I have never had any of my plants disturbed. This type of storage gives my plants a steady, semi-hard and safe dormancy for a period of five months at a cost of $20.00 per month per 8 foot section.

The availability of cold storage should be determined before committing oneself to this type of cultivation, for it is a critical feature. Shop in the yellow pages and meet personally with the manager. Ask questions about their operation and talk about your needs. They are very understanding and cooperative.

During the formative stages of this system of cultivation, I heard the tragic story of a member a few years earlier losing a very large collection of *Sarracenia* to voles (field mice) eating the whole rhizomes of plants while wintering over under mulch. I felt this was not a safe practice to start and growers who are planning on using mulch or those who have been doing so are taking a BIG risk. I just received another sad report of this happening during the winter of '90-91.

"Seasonal Bog"

This structure is basically a customized peat bed, designed and reserved solely for the cultivation of southern *Sarracenia* in baskets.

The bog can be of any length and configuration desired so as to blend in with your landscape, but a width of 36 inches should be maintained. This size is wide enough to accommodate three large lily-type baskets (though intermixing of sizes will probably occur), and narrow enough to install baskets with ease at arms' length from the "front side" of the bog. The periodic maintenance of plants and bog (Hummer 1979:78; Schnell

1976:103, 111; Slack 1980:198), plus the desire to collect plant data also makes this width workable.

The sides of the bog should be vertical so baskets (which are tapered) can be placed right against the edge and have space for buffering agent (peat) to completely surround them.

A bog depth of 12 inches was used. The minimum depth of 8 inches suggested by Hummer (1979:78) is not suitable for basket use. Baskets should sit on an adequate amount of buffering agent (peat) and, if aeration of baskets is needed (to avoid rhizome rot) due to heavy rain flooding, the water table can then be lowered to the base of the largest baskets and still have a water reserve. I envy those growers who have acid water on tap, and an 18 inch maximum bog depth suggested by Slack (Slack 1980:190) to reduce frequency of watering would seem favorable and easy to manipulate, but the overwhelming majority of CP growers are faced with collecting rain water in some form of cistern. Acid water is at a premium. I felt that for the system I was trying to achieve, the extra 6 inches of peat and water was excessive and could compound some problem situations.

To saturate a large volume of peat when setting up your bog can heavily tax one's water supply. More water is then needed to establish a water table, raise it to the desired level and then hold it there daily. Faced with this operation at a critical growing time can make one's hair gray if you run out of water. I assembled my bog in the fall season and added wet peat. This allowed the peat to age over winter and I did not need any more water until spring.

When I first envisioned this system of cultivation, I wanted to avoid the unnatural and unsightly use of lath or cloth shading. Therefore, the system had to be successful in an average back yard location subjected to long hours of full sun and heat with no mid-day shade. I agree with Hummer (1979:78), that *Sarracenia* need plenty of sun for robust growth. The more the merrier.

After evaluating my property for the best morning sun location (Schnell 1976:109) and taking notes on shade patterns for orientation, the best location available was too limited in space and hours of sun due to a Mimosa tree. By a streak of luck, the Mimosa tree died over winter, which upset my wife but suddenly gave me enough space and light to work with. The area receives full unobstructed sunlight from sunrise to about 4:30 P.M. daily, year around.

These environmental factors influenced my concept on bog plumbing. Due to a high evaporation rate (Slack 1980:190), and the need to conserve as much water as possible, drainage holes (Schnell 1976:110; Slack 1980:190) were not incorporated into the bog system.

After two years of monitoring bog water tables, the rate of evaporation averaged 1 inch loss per day ±1/4 inch.

Heavy rain flooding occurs frequently in the wild and will not harm *Sarracenia* if duration is brief. Periodic flooding is also beneficial to your bog in that it helps flush baskets of accumulated salts and balances the pH of compost. I also welcome flooding because of the large amount of water collected.

Actually, it will take a lot of steady rain, possibly over a day or more depending on how heavy, to raise the water table to a flood level reading of 12 inches. Unless storms persist, the water table will drop at a safe rate. If flooding persists more than a day due to continued storms, then draining is advisable to be safe. I have done this only four times in five years.

NOTE: a 1 inch rise of water table does not correspond with 1 inch of rainfall.

To accurately monitor the amount of water in my bog, I crossed over to the tropical fish trade and purchased a section of 3/4 inch diameter rigid plastic tubing, a section of 3/16 inch diameter rigid plastic tubing and a plastic strainer used to keep fish from being sucked into an aquarium filtering system.

The plastic strainer was pushed over one end of the 3/4 inch diameter tubing (if not a tight fit, glue it). I then measured from the end of strainer an overall length of 14 inches, made a mark and cut off (Figure 2B). The length was determined by 12 inches of peat, 1 inch of live sphagnum ground cover with 1 inch left over to extend above moss. The 3/16 a hand trowel. Recheck the depth again from the top of the nail head; this is now your starting point. As you excavate, insert nails 1 foot apart along the bog wall with the nailheads leveled using a spirit level. By the time you end up back at the starting point, you will have a level bog. The finished excavation should be neat, with all stone holes filled in, roots trimmed off and a flat floor (Figure 4). If you want a walkway around your bog, it should be measured out, the sod cut and the soil removed to the desired depth at this time. Back during the planning stage, I determined the bog circumference by laying a piece of string on the graph paper following the contour, then measuring the string to scale. I then ordered from General Foam Plastics Corp. Norfolk, Va. ph. no. 1-804-857-0153, (the makers of 18 inch high children's swimming pools), the amount of plastic wall needed. These walls are sold in 25 foot lengths. After receiving the wall material, I cut the width down to 13 1/2 inches on a table saw and then peeled off the clear sheet of designs.

To fasten wall sections together, I overlapped the ends 3 inches and, with a thin hot nail, I perforated three double sets of holes 1 1/2 inches in from the edge while laying sections for perfect match. The sections were carefully wired together with the twisted wire ends on the outer side of the panel. This long finished panel is not cut to its correct length or the ends united until after installation. This plastic wall subliner is used to protect the main bog liner from puncture holes and, at the same time, providing a lip to prevent lawn soil from washing over and into your bog soil (Slack 1980:192).

To assemble the bog, the long subliner was stood up against the bog wall with the unconnected ends at one end of the bog. The subliner was temporarily held in place with bricks. Wide duct-tape is placed over the inside seams of the subliner where connected to protect the main liner. On the dirt floor, pieces of window screen, tar paper shingles, or other material, is carefully laid down to protect the main liner from holes caused by boring *Cicadia sp.* (17 yr. locust) or similar pests. On top of this covering, a 1/2 inch layer of wet newspaper is neatly placed, fitting all corners and forcing the subliner against the bog wall as you go. After a few years, the paper will decompose into a watertight substance called gley, so that even if the liner is punctured, your bog will retain water. The main liner, which is 6 mil. sheet plastic obtainable in 100 foot rolls from a local agricultural supply store, was cut to a width four times that of the bog and 10 feet longer, due to the bogs' curved shape. This liner was carefully laid inside the bog and at the end of the bog with the connected subliner, the liner was laid over the subliner lip and temporarily held in place with snap-on clothes pins. The liner was fitted to the bog for a short distance and held in place with more clothes pins. I did

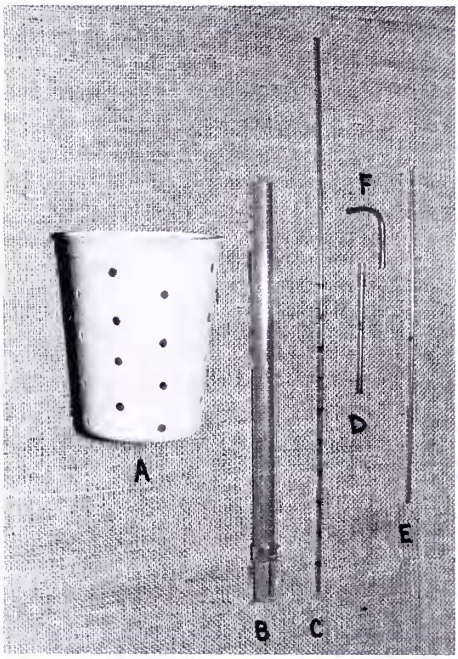

Figure 2. Plumbing Kit

this work while kneeling in the bog. My son then dumped 6 inches of wet peat into that area while I packed it down good. The process of folding pleats, fitting, fastening with clothes pins and dumping peat, continued until the opposite end of the bog was reached. By this time, the subliner has conformed to its finished dimension. Allowing for a 3 inch overlap, excess subliner was cut off with a sharp knife and the ends connected together as mentioned earlier. The main liner was then fitted into this area and peat added. The whole bog was then filled with wet peat to within 1 inch of the lip. Allowing 6 inches of overhang, all excess main liner was trimmed off and the clothes pins removed (Figure 5). At one end of the bog, about 6 inches from the edge, I dug a hole with my hand to where I could see the main liner. I stood the water meter (Figure 2B) up, making sure it wasn't resting on a fold, I then replaced the peat. If you want the white subliner lip to blend in with the soil, you can buy clear primer spray from an auto bodyshop, then use Krylon® brown spray enamel to cover up. Also at this time, your walkway should be filled in to within 2 inches of the bog lip with the material of your choice. The bog is now basically installed (Figure 5).

The remainder of the main liner was trimmed off the following spring after everything settled, at which time the excess main liner is folded over the subliner lip and held in place with snap-on plastic molding strips. The excess main liner was then closely trimmed off. This snap-on trim is not only necessary to hold the main liner in place, but also prevents insects from crawling between the two liners. An unidentified insect made a flat white cocoon on the main liner, underwent metamorphosis and chewed through the liner and into the peat, leaving holes as large as 1 inch in diameter in the liner. I suddenly started using large amounts of water. I exposed a section of liner, suspecting a puncture of some sort. In the spring of 1989, I replaced the main liner. Of all the calculations and reasoning needed to make this method of cultivation work, I had to stumble over something like this!! I was upset with myself with every shovel full of peat I had to remove. So, get that trim on early in the spring. The snap-on molding was also purchased from General Foam Plastics Corp.in 25 foot lengths, and is normally used for pool liners. Order green color molding.

The total cost of constructing the "seasonal bog" portion of my wetland complex, including plumbing material and 7 bales of peat, but excluding baskets and sphagnum moss ground cover (which is an annual expense), was $180.00.

I consider the START of the growing season as that time when it has been determined that all danger of frost has passed, thus allowing plants to be placed in the "seasonal bog". In my area, Mothers' Day is when the local people safely set house plants outside. I've been regulating my spring activities around this local tradition.

The transition of plants from conventional containers to baskets and/or replanting is started in the spring (Slack 1980:198, Schnell 1976:113) four weeks before the growing season begins. Only those plants that need to be converted over or replanted are removed from cold storage at this time; the remainder stay in dormancy. The plants are brought home, watered as in dormancy, (using water that is of room temperature), then placed in indirect light. In response to five months of constant semi-hard dark rest, within 48 hours after bringing plants home, all growth points usually show new growth. I wasn't prepared to experience this aggressive reaction the first time. Conditions are not changed the second week. At the beginning of the third week, replanting is performed. With a modified basket, as described earlier, "bridals' veil" is laid inside and moist compost added. I prefer a compost consisting of a peat perlite ratio of 2-1. Taking the plant rhizome and more compost, I form a mound about an inch above the basket rim (to allow for settling) and the top surface of the rhizome completely exposed. I then carefully firm compost against the rhizome, covering any exposed roots. Excess liner is trimmed off and a plant identification tag is inserted into the basket. A log is kept, listing all plants and the dates that they were put up in baskets. The plants are then set on the lawn and watered lightly with the rose of a can

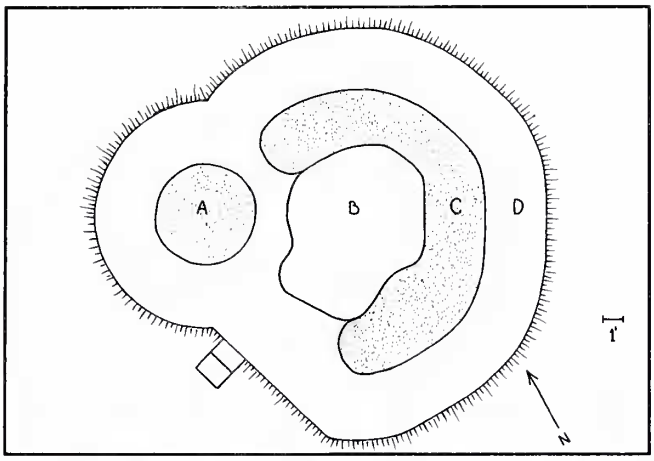

Figure 3. Diagam of wetland complex

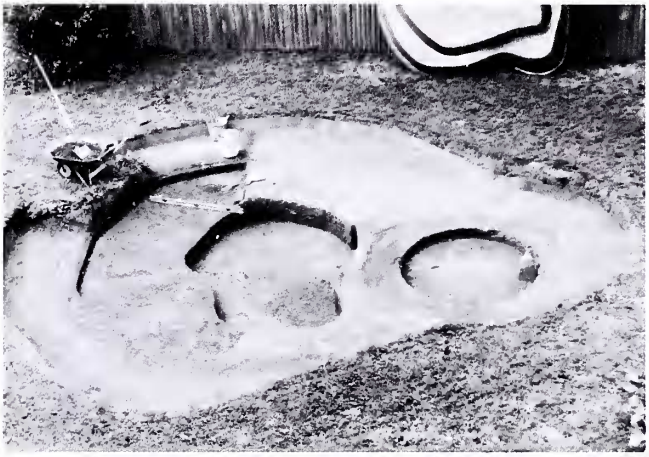
Figure 4. View of excavation for wetland complex in September 1985


Figure 5. View of wetland complex after installation in October 1985

and exposed rhizomes are misted with Benomyl®, then placed on our porch for the next two weeks, making sure that they receive only indirect light and the compost does not dry out. This period of porch time allows plants to adjust to fluctuations of day and night temperatures, air currents and photoperiod. The transition from dormancy to a growing cycle is a VERY important element (Schnell 1976:97) and should not be bypassed. If during this time there's a last minute drop in temperature, foliage will not be harmed by frost because of protection by the porch roof.

It must be said, that because of the time involved adjusting plants from pot culture to baskets and then to the "seasonal bog", size and shape of the first pitchers will be sacrificed the first year.

Every spring about two weeks before the start of the growing season, I remove by hand any accumulated debris and all remnants of sphagnum moss from last year's ground cover from bog surface. With an "onion rake", I carefully till the upper 4-6 inches of peat, watching not to snag the sides of the main liner. The peat removed the year before during installation of baskets is once again added to fill in all depressions. The peat is then carefully raked level with a regular iron rake and, if needed due to settling, new wet peat is added to within one inch of the bog lip. At this time, to insure that the water meter (Figure 2B) is resting on the bottom of the bog, I twist and push down on it. The gauge tube (Figure 2C) is then dropped in. At the opposite end of the bog, I insert the watering pot (Figure 2A) to its rim. A piece of flat bark is then laid on top to conceal the pot and act as a cover. You may or may not have a water reading on your gauge tube, but a high water table is not needed at this time.

On the Saturday closest to the first of May, the plants which are in baskets are brought home from cold storage. Upon arrival at home, baskets are set on the lawn and watered well using the rose of a can. Exposed rhizomes are misted with fungicide and baskets are left to drain a few minutes. Plants are then placed on our porch for the remainder of the week, making sure that they receive only indirect light and that compost does not dry out. The plants are kept on the porch for at least seven days if the weather has been abnormally warm for a while or they remain on the porch until the Saturday closest to Mothers' Day if you fear the chance of a last minute frost. Both types of transition periods have produced 3 inch pitchers and/or 5 to 6 inch flower scapes during this time.

On the day that my plants are to be placed in the "seasonal bog", I mentally arrange the plants so that the smaller varieties are toward the "front" of the bog for best observation and east of the taller pitcher plants (Schnell 1976:110, 111) so that they are not shaded and deprived of valuable morning sun.

Starting at one end of the bog, I take an empty basket of the size that is to be placed into the bog and lay it on the surface upside down in the location desired and trace the outline with the tip of a small hand shovel. I proceed to dig a hole to the shape of the basket, putting the peat that is removed into a bucket which is later stored in a garbage bag. The empty basket is placed in the hole to judge proper fit. Once the basket sets in the hole with the rim level with the surface, I look into it to see if the peat is against all sides. The bottom of the basket should be sitting firmly on peat also. If I see any open spaces or pockets where peat is not up against the basket, I add peat to that area and then replace the basket and recheck. Any air pockets left unfilled will have a negative effect on the proper hydration that the plant needs. Once I'm satisfied with the inside of the hole, I remove the empty basket and insert a planted basket. This process is repeated across the bog for every plant (Figure 6).

As I work my way across the bog, I carefully lay an inch of live sphagnum moss around the plants (Figure 6), making sure NOT to cover any growth points or rhizomes, for rot may occur. The moss not only conceals the baskets but also serves as a protection for the baskets from damaging ultra-violet light rays, at the same time preventing peat from splashing onto foliage during a rain. Hummer's (1979:78) suggestion that one

Figure 6. Detail of 'planting'

need not cover the bog surface completely because the moss will grow cannot be applied to a temporary "seasonal" bog, where results are short lived but needed immediately. In areas of my bog that cannot be planted for want of plants, I don't bother covering with moss. Isolated plantings are still surrounded with moss which gives the bog a special effect.

On initial exposure to full sun after plants are installed in the bog, there will be a moderate sunburn experienced, which never gave me reason to be concerned for my plants. York, Pennsylvania receives only a 50% average per year of sun bright enough to cast a shadow, as compared to a 65% average for the Green Swamp of North Carolina (Antolini 1978:36). As a result, I haven't attempted to protect nor do I recommend the shading of any southern *Sarracenia* for coloration of foliage will be sacrificed particularly the all red variants. *S. purpurea ssp. venosa* shows no negative effects from this unobstructed exposure level as suggested by Schnell (1976:106,111) to avoid in a more intense southern location.

Upon completion of plant installation and the laying of moss, which is done on a Saturday because of the workload involved, I proceed to fill the bog with water and establish a water table. I'm currently operating my system with approximately a 7 inch water table that is read off the gauge tube. This puts the water table approximately 5 inches below the plant rhizomes, which seems to provide a good degree of hydration. I plan to experiment cautiously with a higher water table in the future. For the size of my bog, I usually start with 32 gallons of water, which is added via the watering pot. When adding water, it takes about an hour or so for it to seep through the peat and reach the water gauge at the far end before an accurate reading can be made. Once the water has stopped moving up the gauge tube, more water is then added if needed to reach the level desired. Once this is accomplished, your system is in operation.

Besides the raising of the water table due to rain and the average daily loss of an inch of water caused by evaporation, I check daily and, if needed, I add water to maintain at least a 7 inch water table until all pitchers have completely opened; for I agree with Schnell (1976:98,106) that an even, constant, high water table is critical to achieve maximum growth.

To avoid the time consuming task of adding water everyday, waiting to see how far it moves up the gauge tube, then adding more water if needed, on a day that watering was needed, I took a reading, poured two buckets (plastic) of water into the watering pot, waited two hours to make sure that the seepage was complete, took a second reading and calculated out how many buckets of water would be needed to raise the water table one inch. As a result of this test, I can come home from work, take a reading and, if the water table is down one inch, I just add three buckets of water and go about my business without rechecking.

For the first two weeks, to accelerate the establishment of the sphagnum ground cover, every other day that I must add water, I pour that day's required amount over the moss using the rose of a can. Then, for the remainder of the season, once a week (if it doesn't rain), I'll take that day's water and pour it on all the plant rhizomes (using the rose of a can) as a treat. I do not consider this a necessity though.

Besides the required watering, once a week I mist my plants (Schnell 1976:106) using a heavy duty pressure sprayer as advertised in garden and seed catalogues. This is performed solely for the purpose of keeping the pitchers' esophagus moist, which is needed for the plant to absorb nutrients from the biomass. I aim the mist directly, but moderately, at the pitcher openings. This application is helpful when the air might become periodically dry. I also direct a shot of water at newly opened *S. purpurea* pitchers, to give them a head start for they require a high humidity (Schnell 1976:106).

All this watering might seem burdensome, but actually I spend about a half hour a day at watering the whole backyard complex. This is always done in the cool of the evening, never in the hot direct sun so as to avoid plant shock and leaf scorching.

Once all pitchers have opened, I am not fussy about maintaining a daily 7 inch water table. During the drought of 1987, I deliberately cut back on water to conserve, which meant that if I had a water reading of 6 inches I was good for six days. I once stopped watering with a 7 inch reading and didn't add water for fourteen days (during which time there was no rain) with no ill effect to the plants for the peat was still damp and cool, which is important for the plants' roots. This proves excellent for making it possible to go on vacation by raising the water table to a 12 inch reading before going on vacation for two weeks. After returning from vacation, water is added until a 7 inch water table is achieved, which is why I felt that an 18 inch deep peat bed, as mentioned earlier, was excessive. If one allows the bog to go dry, it would require 13 inches of water instead of 7 inches to recover.

At least once a year (usually in the fall), the pH and TDS (total dissolved solids) of your bog should be monitored. With most *Sarracenia* species growing in an acidity range of 4.5-4.7 (Wherry 1929), it is my opinion that a higher pH level would have a negative impact on the plants' metabolism and disease resistance system. As a result, I consider the bog peat useless once it reaches 5.0 (5 times weaker than 4.5) at which time it should be replaced. I use the La Motte model P-BEG (code 2105) pH test kit (Stahle 1987:8). As for TDS, Stoutamire (1972:6) reports that "mixtures in which *Sarracenia, Drosera* and *Sphagnum* mosses grow", range from 20-40 uMho; 40 micromhos equaling 28 ppm. To avoid a high level of toxicity, I'm following Schnell's (1976:97) recommendation that TDS "should be less than 50 parts per million (equivalent to 100 micromhos—)". A local nursery man has been kindly testing the TDS for me but one can purchase a small test kit from La Motte. I siphon my two samples of water from the bottom level of the bog using a length of rigid tubing without an elbow (Figure 2E). Yearly test results for both pH and TDS are entered into a log so I can monitor the deterioration in bog quality. Since tipping (Schnell 1976:101) is impossible as a means of flushing out toxic levels of salts, one could siphon all the water out of the bog after a heavy rain to possibly add another year's life to the peat. I will most likely change the peat. It is my goal at this time to maintain at least a seven year repotting cycle. This time span will be determined by the condition of the bog peat and when it will need to be replaced based on the levels of pH and TDS, whichever becomes unacceptable first. I'm counting on the bog peat to last at least five years, if not longer. The bog peat should always be replaced first which, in turn, will buffer the planting compost by seepage, thus adding another year to the usefulness of the compost. If this sequence would be reversed, the new planting compost would be wrongfully affected.

One manifestation of "season bog" cultivation resulting from total darkness and unfluctuating temperatures for five months of cold storage is that all my southern *Sarracenia* have the same flowering date peaks. Admittedly, this observation was

made based on a meager sample of two purchased plants representing the Gulf Coast (30° N. Lat.), but the remainder consisted of purchased or collected representatives of all species commonly colonizing the North Carolina coastal plain (35° N. Lat.). Regardless of latitude or species, a two year average of flowering date peaks was fifteen days after baskets were installed in the bog as opposed to Schnell's comparison of greenhouse and native habitat flowering date peaks (1977:168).

First year cultivation at 39°58' N. Lat. was also confusing to some plants because of day length and temperatures, resulting in three *S. flava* clones producing flowers on four to six inch scapes the first week of September. This manifestation didn't occur the second year once the plants became regulated.

Of two *S. flava* hybrid clones salvaged (Schnell 1976:113) within two feet of each other from Brunswick Co., N.C., one of these clones has produced a second crop of pitchers of normal height in early September since being in cultivation.

Come mid-September, I discontinue adding water to the bog and let the weather control the water table in order to prepare the plants for the dormancy period ahead (Schnell 1976:106). At times, there may not have been a readable water table but my bog has never dried out completely.

When I get up in the morning and have to scrape ice off my windshield (which has been occurring in my area about mid November), it's that time for me to prepare my plants for cold storage.

In the evenings, a couple of baskets at a time are "lifted" from the bog and set on the lawn to drain. Afterwards, they are brought into the house to be cleaned up. All peat is brushed off the outside of the baskets and any roots growing through the basket are carefully trimmed off. Directing my attention next to the top of the basket, all moss and grasses are carefully removed.

When it comes to prepping *Sarracenia* , I try to retain as much foliage as possible (Slack 1980:198), at the same time thinning out foliage and eliminating the possibilities of insects being carried over to the next season, by removing all completely formed tubes. As a result, on those species that produce winter phyllodia, the phyllodia are retained (Schnell 1976:111) and all tubes (even if still green) are carefully trimmed off as close to the rhizome as possible with a pair of manicuring scissors. Any dead ends of the remaining foliage are trimmed off. For those species that do not produce phyllodia and whose pitchers can survive in protected areas (Schnell 1976:34, 37-44), I trim off half the foliage from each growth point, preferably saving incompletely formed tubes.

S. purpurea ssp. is truly an evergreen species. Tests conducted by me during a four year period confirms that this species stores its nutrients in its foliage and to cut off the foliage will set the plant back causing a very slow recovery, if not death. The following season, only the completely dead foliage should be removed from this plant. I instinctively treat *S.* x *catesbaei* with the same respect. For those growers that are custodians to other *S. purpurea* hybrids, it might be of value to consider this aspect.

Once all unwanted foliage is removed, compost is repacked up against the rhizome to eliminate any air spaces underneath. The rhizome is then misted with fungicide. The plants are now ready for storage. They can be placed in cold storage as they become ready or kept in a cool basement and taken into storage at one time, which I normally do the first of December. This two week period has no negative effect on my plants.

So that I don't forget, the gauge tube (Figure 2C) is brought indoors at this time so as not to freeze and break.

The moss removed from the tops of baskets, and that which remains on the bog surface, is not kept for the following year even though replacement involves some cost, because of the grasses, etc., that sprout up during the summer which can give your bog a natural effect but are very difficult to separate from the moss for the next year. If this moss is reused, these weeds, would get out of control. I consider the time I spend

around my wetland complex valuable and, if I spent unnecessary time weeding, that would rob me of time spent working with and enjoying my *Sarracenia*. Therefore, I only take time to weed out my northern bog of unwanted growth. The ordering of sphagnum moss is, other than cold storage fees, my only annual overhead. Moss is ordered early in the Spring from: Mosser Lee; County "O" & I-94; Box 437; Millston, Wisconsin 54643-0437.

When renting a section of cold storage rack, make sure that the space you obtain is not located right below the cooling system. In order to maintain a 33° F. temperature at the far end of the building, a colder air output is needed and,if plants are right below the cooling unit, they will freeze. This happened to me during the third year of dormancy when I failed to check where my reserved space was located. Then, three weeks after storing plants, all the bulky stock above my plants was removed from storage, forcing all that cold air down through the racks and onto my plants. So reserve space ahead of time to insure available space and a safe location.

ALL *Sarracenia* can take a mild freeze, but the period of transition from storage to bog is a sensitive one. You do not want to take your plants out of storage and shock them by putting them immediately into the hot sun. At the same time, you do not want to keep the plants in a protected area longer than necessary where you can retard and deform the foliage because of inadequate hydration and light. As mentioned earlier, plants will come out of dormancy quickly, but this freeze of 30° F., which I consider mild, caused an additional two weeks for the plants to recover (causing me frustration) because of heat. I lost six plants to stress from forcing them too hard; so beware.

On the day my plants are to be transplanted to cold storage, they are watered and sprayed with fungicide as in dormancy. Contrary to popular beliefs, if you keep *Sarracenia* outside untiI the first hard frost, which gives your plants' natural "antifreeze" system a chance to activate (Mellichamp 1981:52), your plants can be stored in wet compost without fear of rot. When I hear of growers losing plants because of rhizome rot during dormancy, the problem can usually be traced to not allowing plants to remain outside long enough for their antifreeze system to kick in and/or plants are stored in a basement which is not cold enough (33-35°F) and/or the temperature is not kept constant, which will negate the plants' "antifreeze" (dormancy) system. My baskets are not allowed to dry out and, in fact, are kept wet at all times. Potted plants are also kept outside until frost and then stored wet with no negative effects.

My maintenance program for dormancy is as follows: Every Saturday morning, I check my plants to make sure that the baskets didn't dry out. Because of the air

circulation system, you might have to go twice a week until you get familiar with the evaporation rate. I take with me a couple of plastic containers of water, a spray bottle of fungicide and a small plastic watering container with a curved spout without a rose. I first spray with fungicide if I see any white fuzzy growth starting on top of the compost or rhizome. Even though this might occur (which it did one year) with a weekly spraying to eradicate fungi as needed, my plants have never been affected. Water is carefully applied to the compost, avoiding contact with the rhizome (which can cause fungus to start), by rotating the basket as I water. Only fungicide is allowed to come in contact with plant rhizomes.

Going into my sixth growing season, an evaluation of this system in relationship to the plants can be made.

Due to a high acid level (pH 4.0) as opposed to pot culture leaching, coloration is improved (provided ample sun is received). Plant growth is very aggressive causing multi-growth point clumping reminiscent of Green Swamp plants, as one grower observed. Even Gulf Coast plants that normally produce but one growth point branch off creating large clumps. Since this system of cultivation was started, I have had the opportunity to see a large number of "southern" beds in operation, basically following Carroll's (1982:84) format. With one notable exception, coastal plain mix was substituted for peat in all cases. I have not seen the robust growth that I am accustomed to in my system. This is most likely due to differences in hydration. The root systems are stronger and triple in mass than those produced in sand beds.

On the other hand, *S. minor* does only fair in my system. This requires more work. I also have not achieved the pitcher height yet that I would like to see in some species. This might be due to not subjecting my plants to a water table higher than 7 inches at the very start of the growing season which could possibly force the plants too hard (Schnell 1976:97). More work needs to be done concerning this. Putting aside the six plants that were lost because of MY failure to insure that the plants would not freeze as mentioned earlier, keeping within the framework of the system outlined, I have not been able to keep *S. purpurea ssp. venosa* alive through the third dormancy cycle. This is a double-edged sword for me because the foliage MUST be retained from one year to the next, causing the foliage to cover the rhizome resulting in poor ventilation. The plant cannot be properly sprayed with fungicide and then dies. This is only a preliminary evaluation. I have not grown *S. psittacina* yet but I can see this problem possibly occurring with this species also.

From the beginning, it has been my intent to create a good system of cultivating *Sarracenia* for the northern grower. Some of the many tests that I have subjected my plants to could be called "reckless". In come cases, I have done the opposite of what I had read not to do. These plants are not as fragile as I earlier understood. There always will be tests to perform, manifestations to evaluate and possibly changes for improved cultivation, but then again *Sarracenia* has the ability to consume one's curiosity. Hopefully, this system will open the door for more northern growers.

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UPCOMING ARTICLES

- A Slow Sunday at the Greenhouse
- Mechanisms of Trap Movement II: *Aldrovanda*
- CP in Ireland III: David Moore
- A Letter from Sierra Leone, re: *Triphyophyllum peltatum*
- CP Tour of South America
- *Nepenthes* at Longwood Gardens - an Update After 12 Years